

Impacts of an ice-diminished Arctic on Alaska coastal communities

Hajo Eicken

Geophysical Institute & International Arctic Research Center, University of Alaska Fairbanks

Fairbanks, AK 99775-7320, USA

e-mail: hajo.eicken@gi.alaska.edu

- Sea ice services & ice use
- Community-based observations & fall freeze-up
- Ice use as platform in spring
- An integrated ice observatory



Sea-ice services

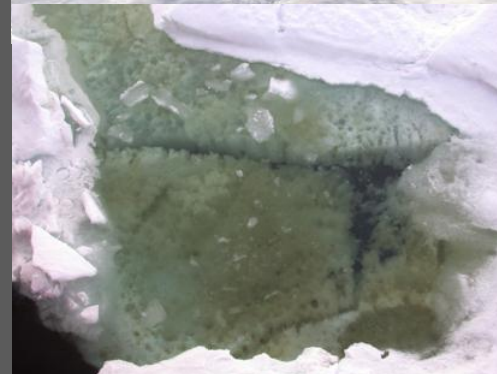
- **Regulating services**
 - Climate regulator
 - *Marine & coastal hazard*
 - Stabilizing element in coastal zone
 - Geologic agent (ice rafting of sediments, bottom interaction)
- **Supporting services**
 - Ice-based foodwebs
 - Reservoir and driver of biological diversity (e.g., extremophiles)
- **Provisioning services**
 - *Transportation corridor*
 - *Platform (subsistence & industry)*
 - Freshwater source
 - Source of food
- **Cultural services**
 - *Subsistence activities*
 - Ice as part of cultural & spiritual landscape (incl. tourism)



(1) Icescape



(2) Platform
&
Hazard

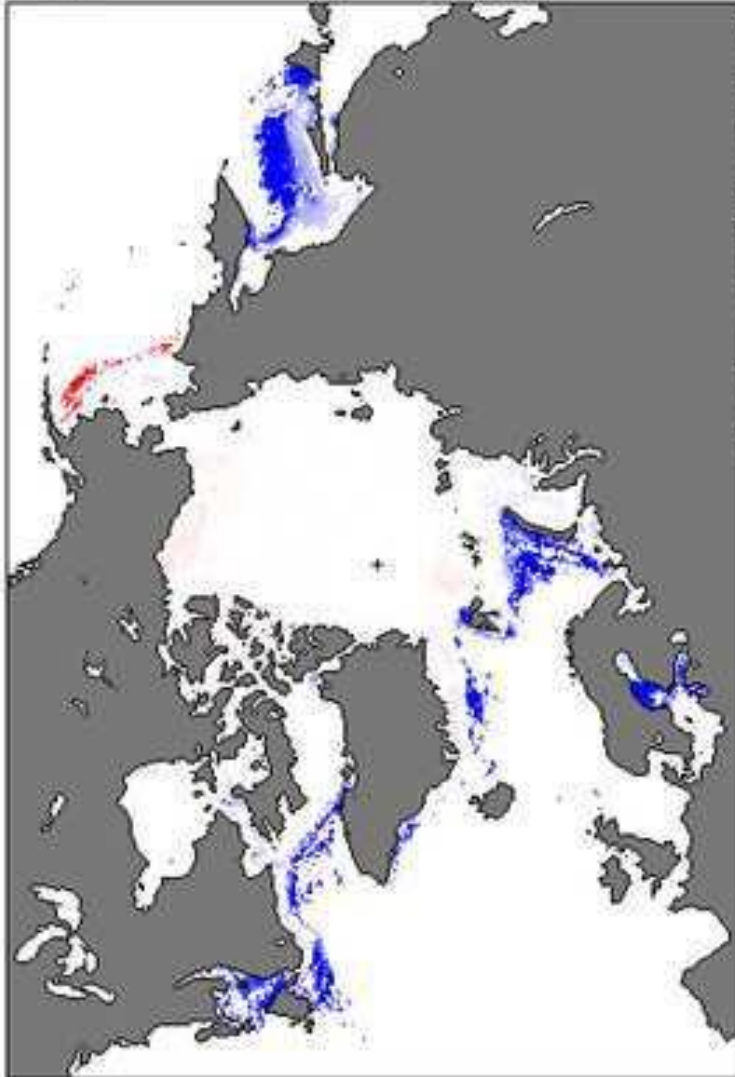


(3) Habitat

Eicken et al.,
Arctic, 2009

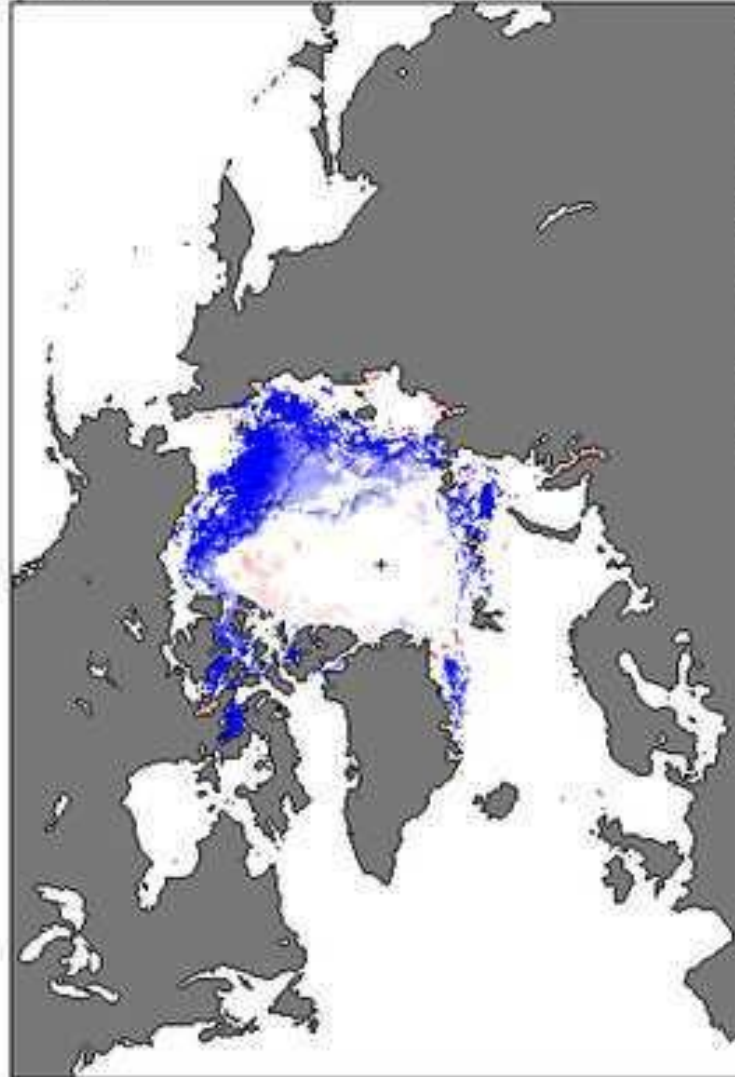
Arctic sea ice concentration trends

Sea Ice Concentration Trends
Mar 2010

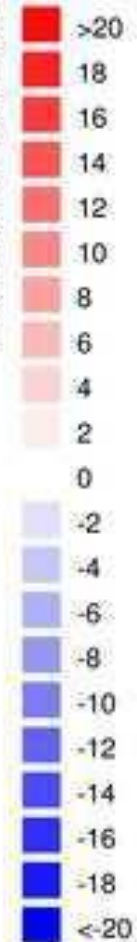


National Snow and Ice Data Center, Boulder, CO

Sea Ice Concentration Trends
Sep 2010

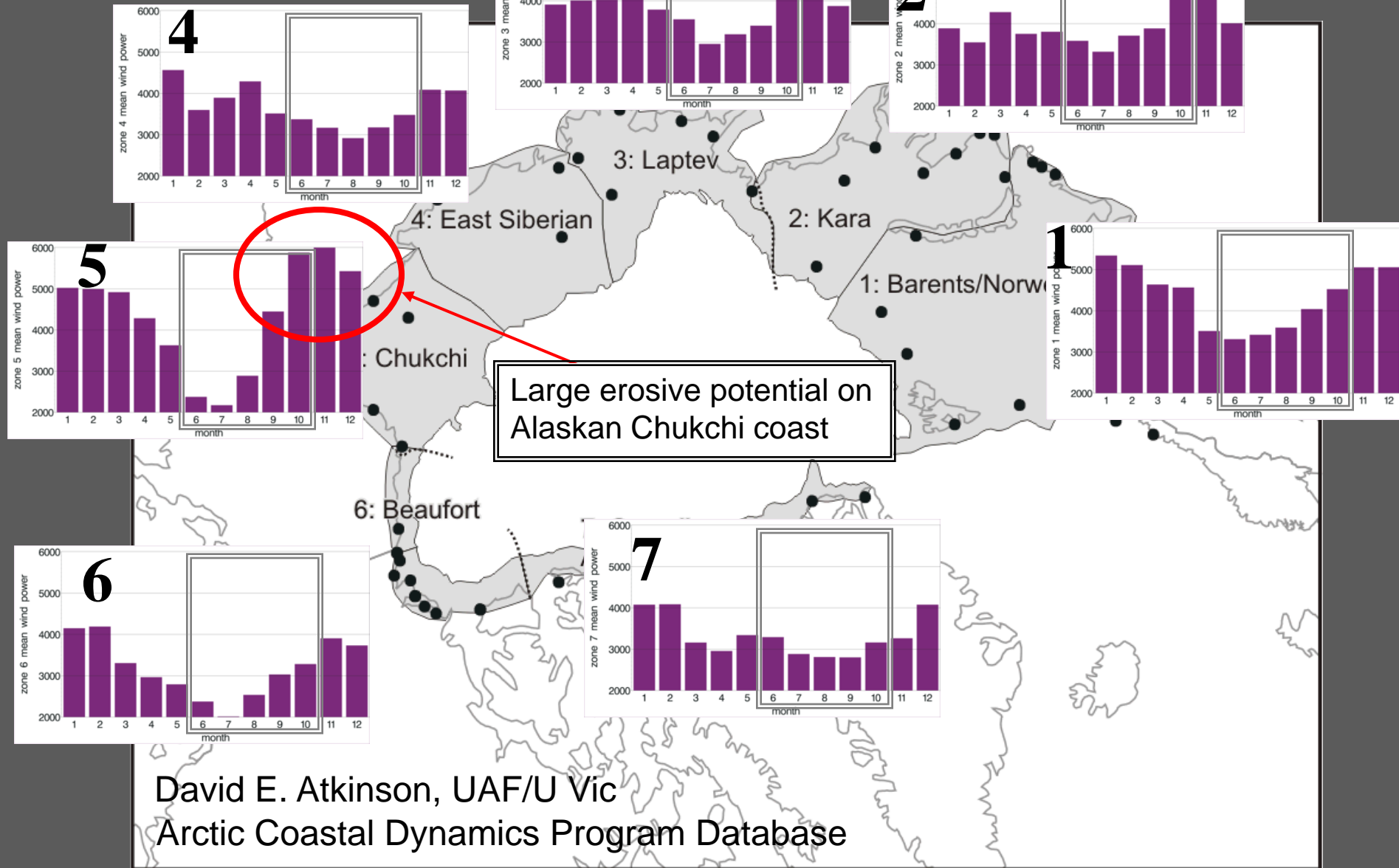


National Snow and Ice Data Center, Boulder, CO



% per decade

Storm mean power



Impacts of an ice-diminished Arctic on Alaska coastal communities



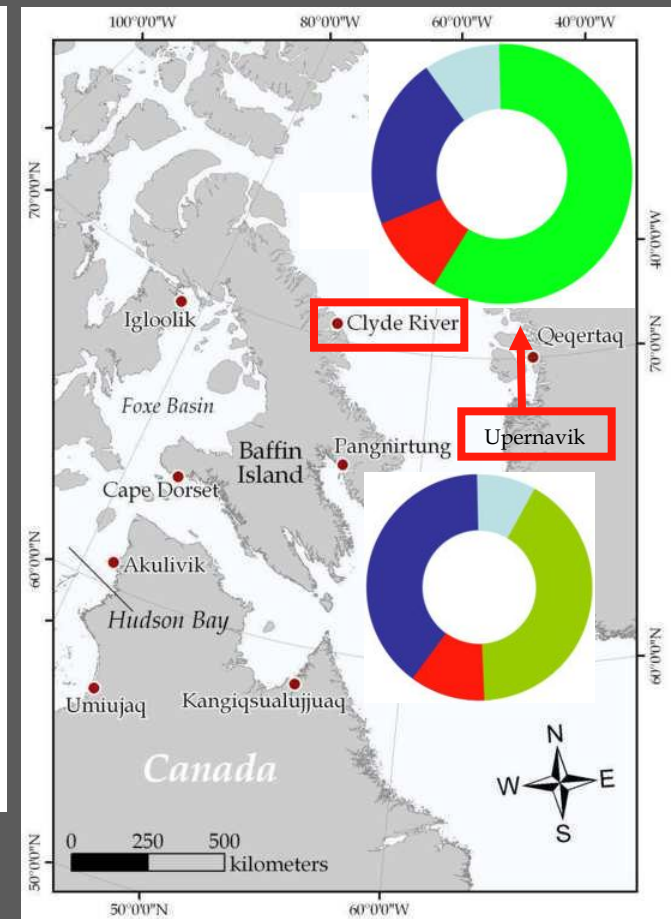
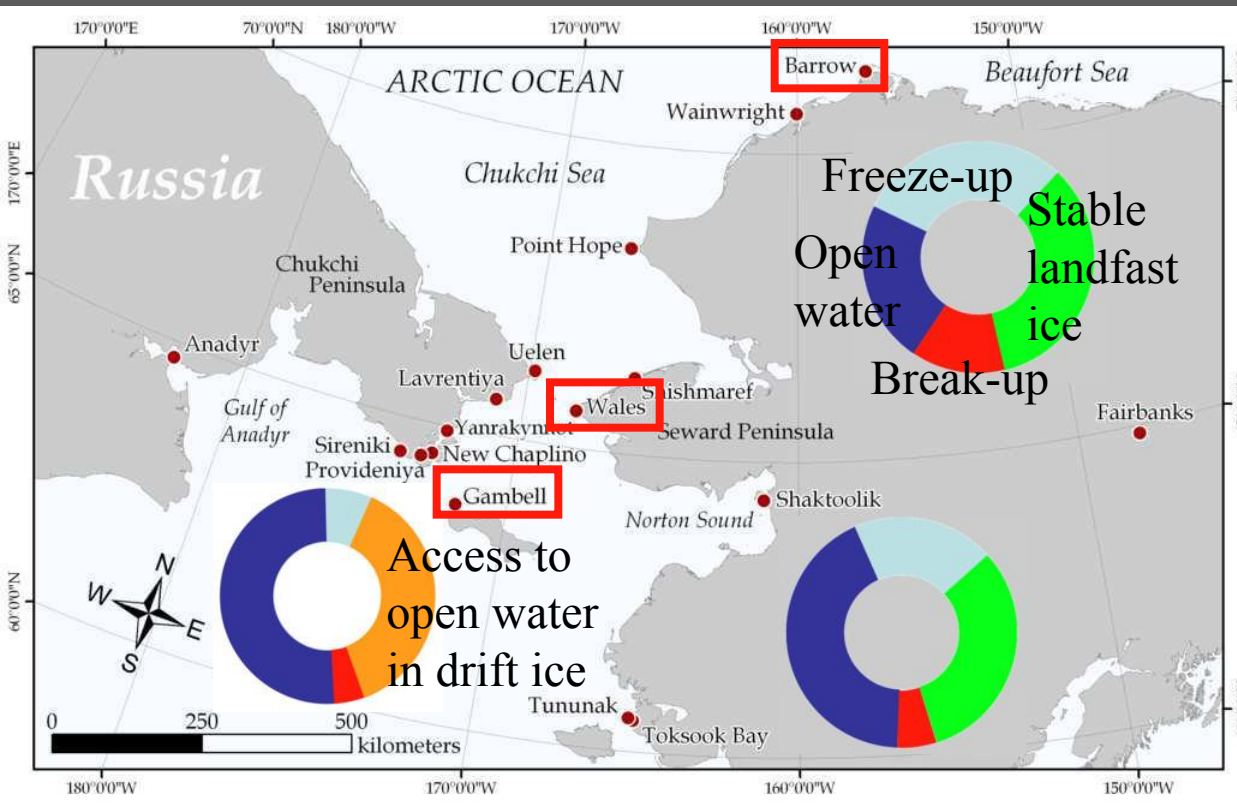
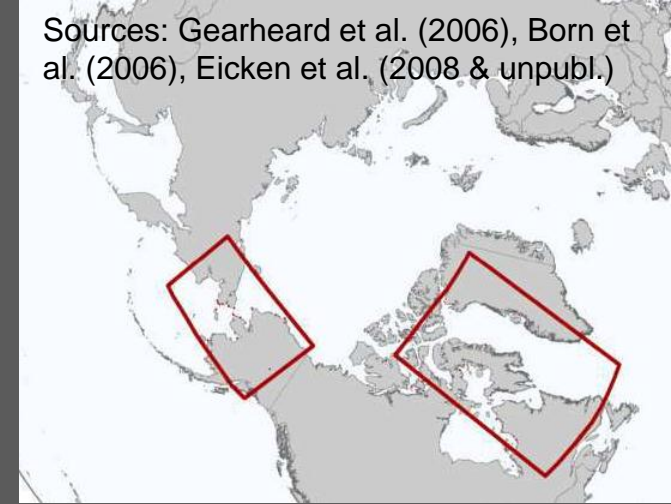
- Sea ice services & ice use
- Community-based observations & fall freeze-up
- Ice use as platform in spring
- An integrated ice observatory

Sea-ice Knowledge & Use (SIKU)

IPY-4 Project

- 60 researchers & 30 Arctic communities
- Ice use studied in more than a dozen villages (community-based observations, dictionaries)
- Krupnik, Gearheard, Aporta, Laidler and others

Sources: Gearheard et al. (2006), Born et al. (2006), Eicken et al. (2008 & unpubl.)



Collaborating Iñupiaq & Yupik sea-ice experts



- Winton Weyapuk Jr.
(Wales)
- Joe Leavitt (Barrow)
- Leonard Apangalook Sr.
(Gambell)

Observations of freeze-up

W. Weyapuk Ice Log

8 Nov 2007

...There is a **slush berm** about 3 to 4 feet high right along the tide line. Light slush in front of the village 1/4 to 1/2 mile wide.

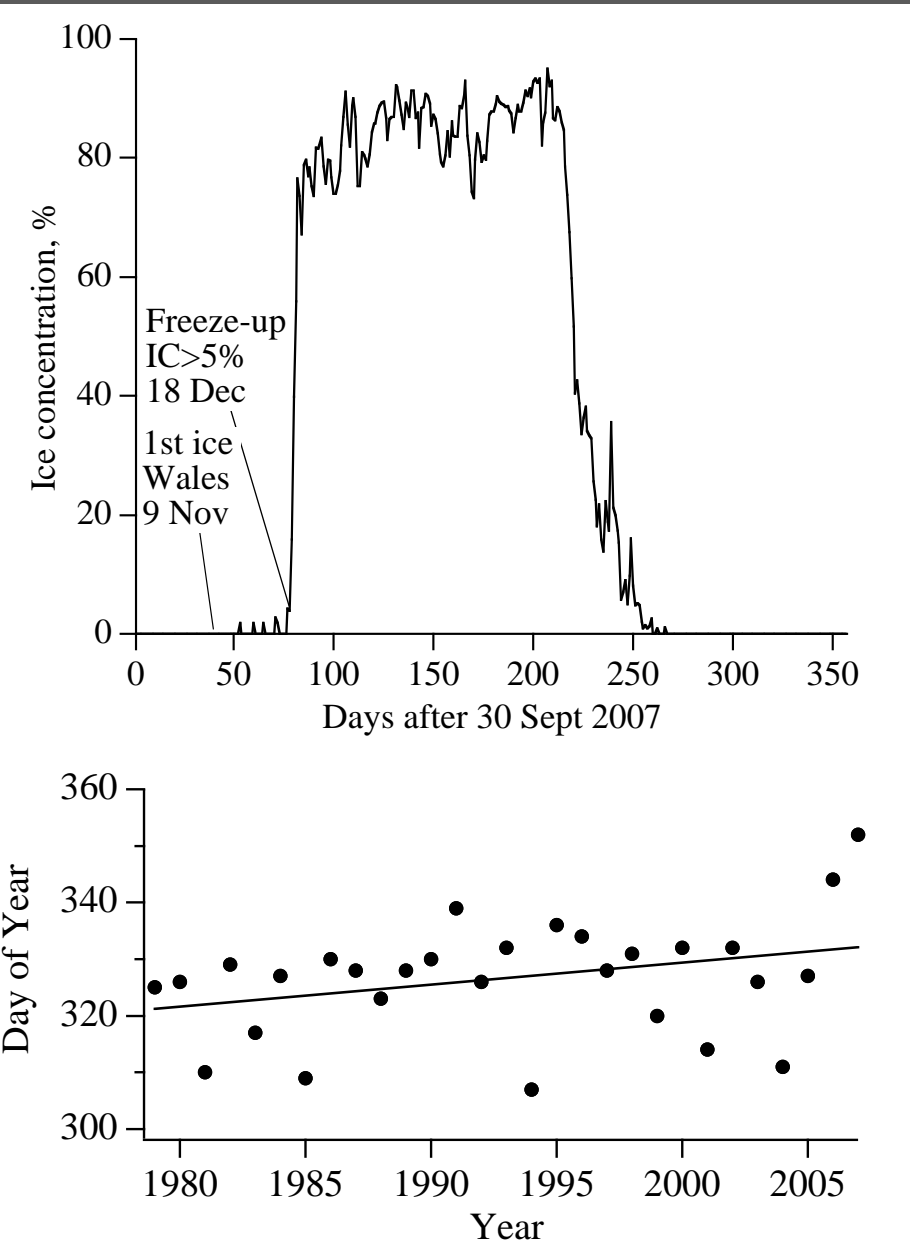
Local observations in Wales, Shishmaref and Shaktoolik:

- Slush ice berms protect coast from fall storms



Photo: Winton Weyapuk Jr.

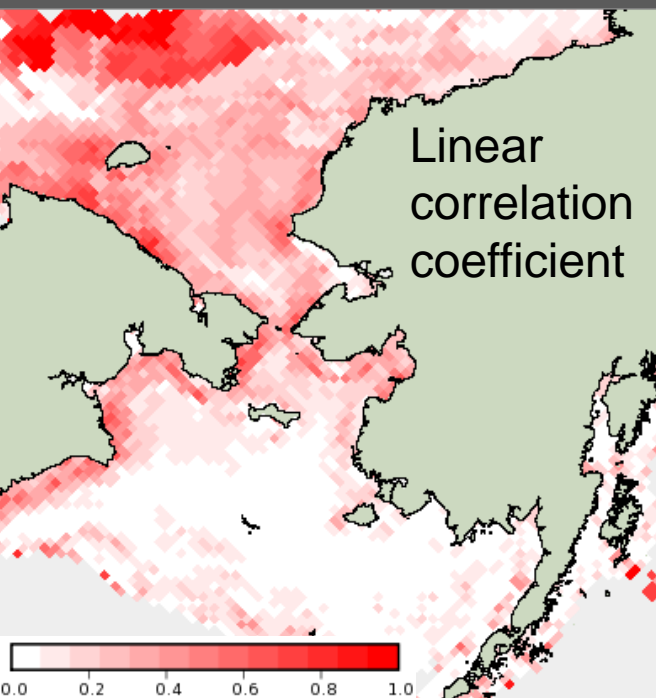
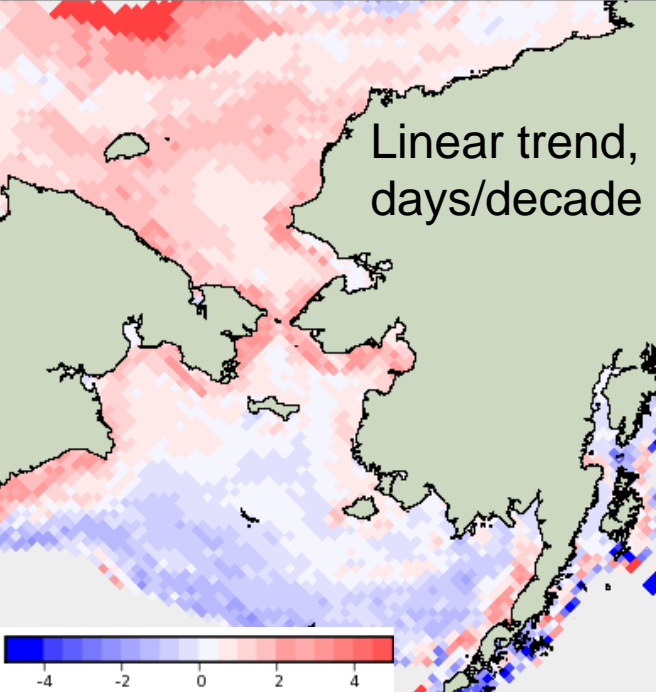
Freeze-up trends from remote sensing data



- Passive microwave data (SMMR, SSM/I), 1979-2008
- Definition of freezeup based on seasonal cycle and criteria established by local observers
- Wales: 4 days/decade delay in onset of freeze-up ($R = 0.32$)

Onset of freeze-up trends from remote sensing data

- Spatially consistent, significant trends with freeze-up delayed by up to 2-3 days per decade
- Increases in duration of freeze-up season modest (< 2 d/decade) and not significant
- Norton Sound, Bering Straits region, southern Chukchi Sea coasts



Impacts of an ice-diminished Arctic on Alaska coastal communities



- Sea ice services & ice use
- Community-based observations & fall freeze-up
- Ice use as platform in spring
- An integrated ice observatory

Use of sea ice as a platform

- Walrus life cycle tied to sea-ice cycle
- Ice floes as diving platforms for feeding over shallow shelf

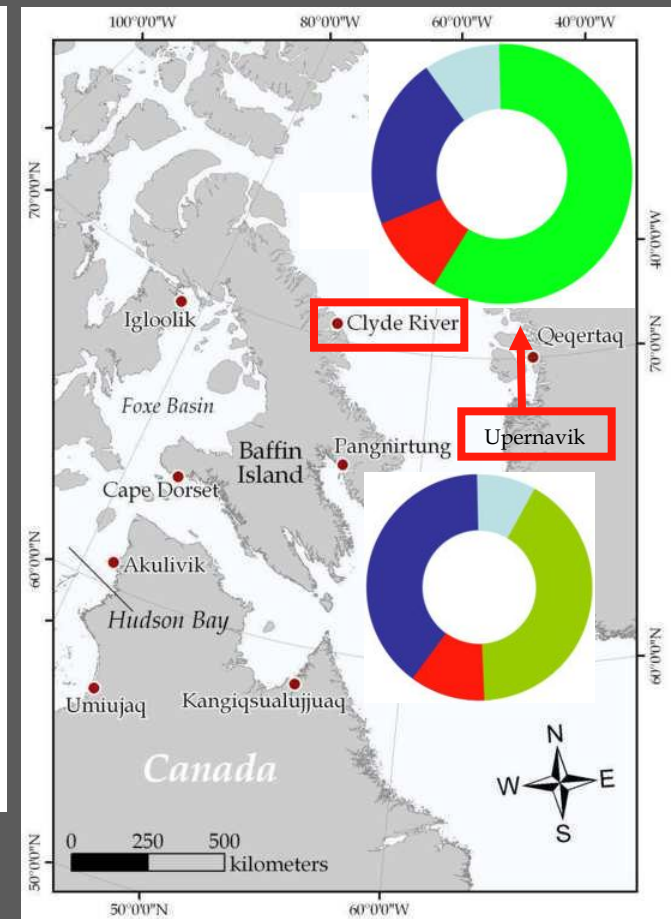
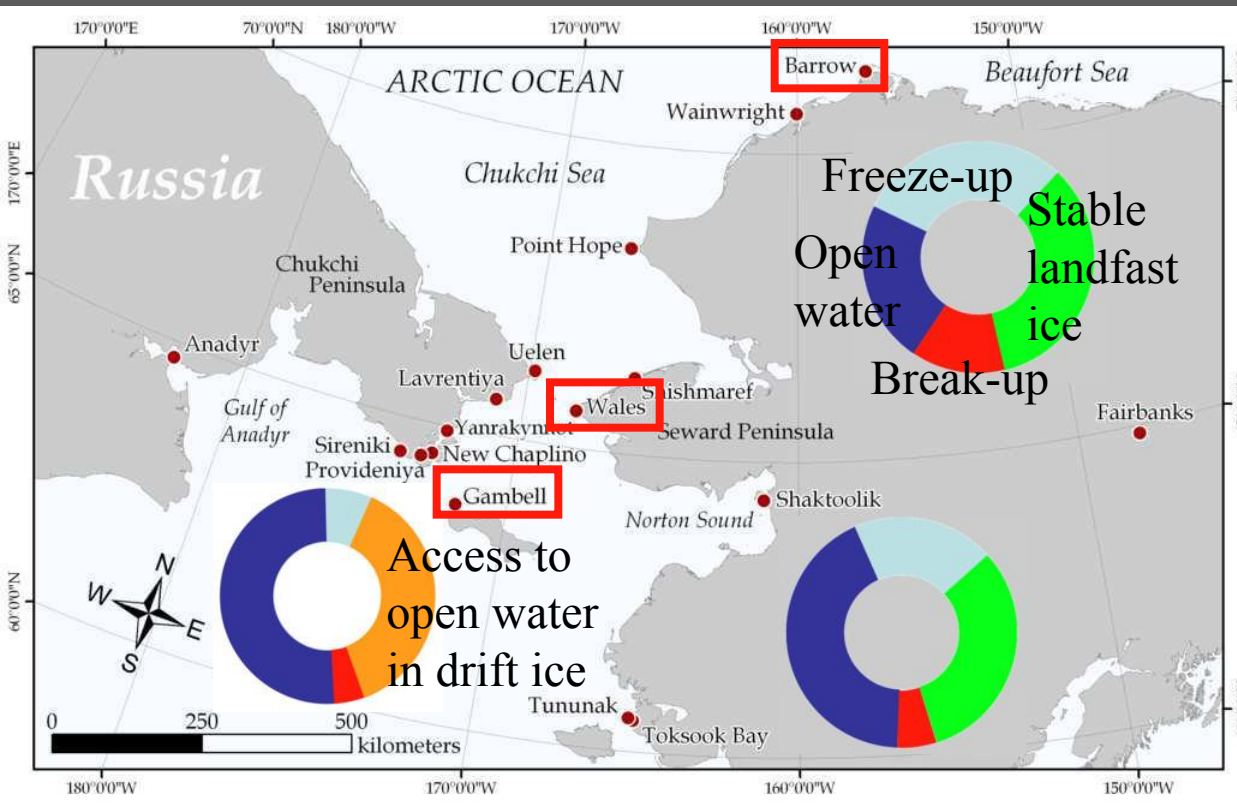
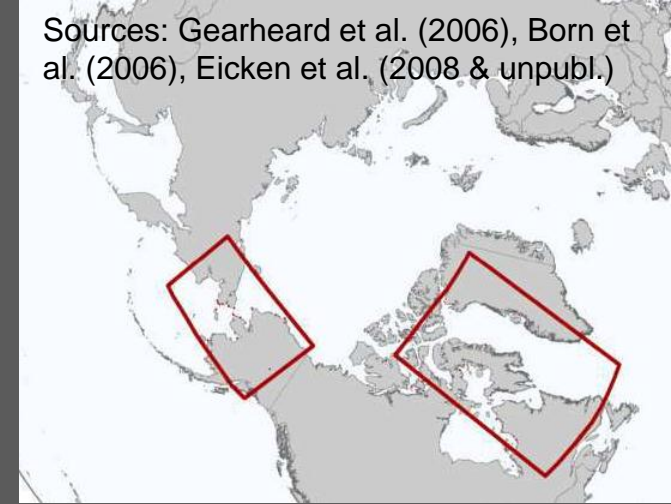


Sea-ice Knowledge & Use (SIKU)

IPY-4 Project

- 60 researchers & 30 Arctic communities
- Ice use studied in more than a dozen villages (community-based observations, dictionaries)
- Krupnik, Gearheard, Aporta, Laidler and others

Sources: Gearheard et al. (2006), Born et al. (2006), Eicken et al. (2008 & unpubl.)





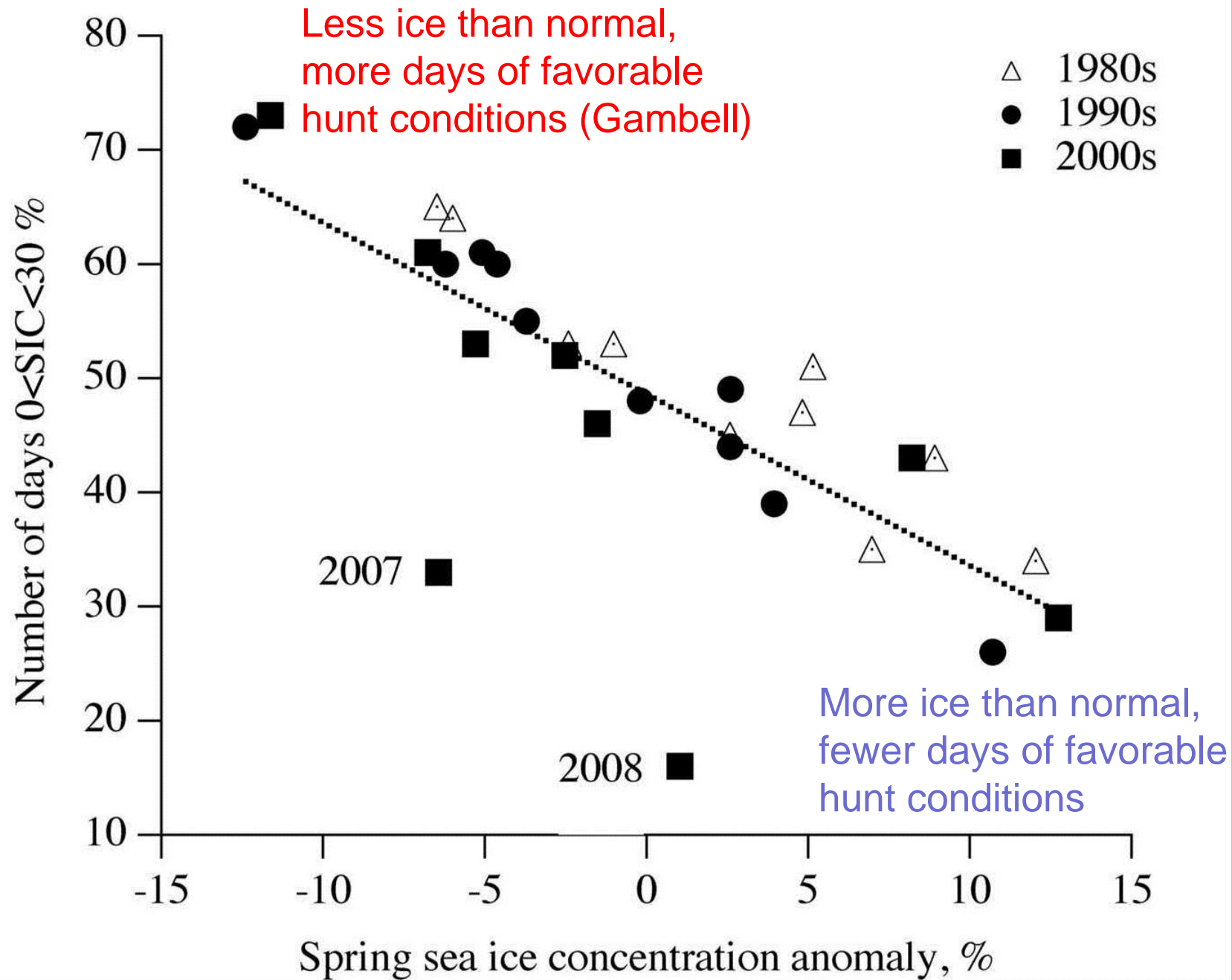
- Use of sea ice as platform by marine mammals (walrus, seals)
- Use of sea ice for access to walrus and ice seals by Bering Straits hunters

Photos: Winton Weyapuk Jr.

Simplistic model of favorable conditions for walrus hunt in Savoonga & Gambell

- Ice & weather observations by local experts
- Sea-ice satellite data
- Weather data
- State & federal harvest monitoring programs
- Variables: sea ice concentration, wind speed & direction, air temperature, visibility & cloud cover
- Favorable conditions:
 - <30% ice conc.,
 - winds <5 m/s out of S/E sector (Savoonga),
 - winds < 9 m/s

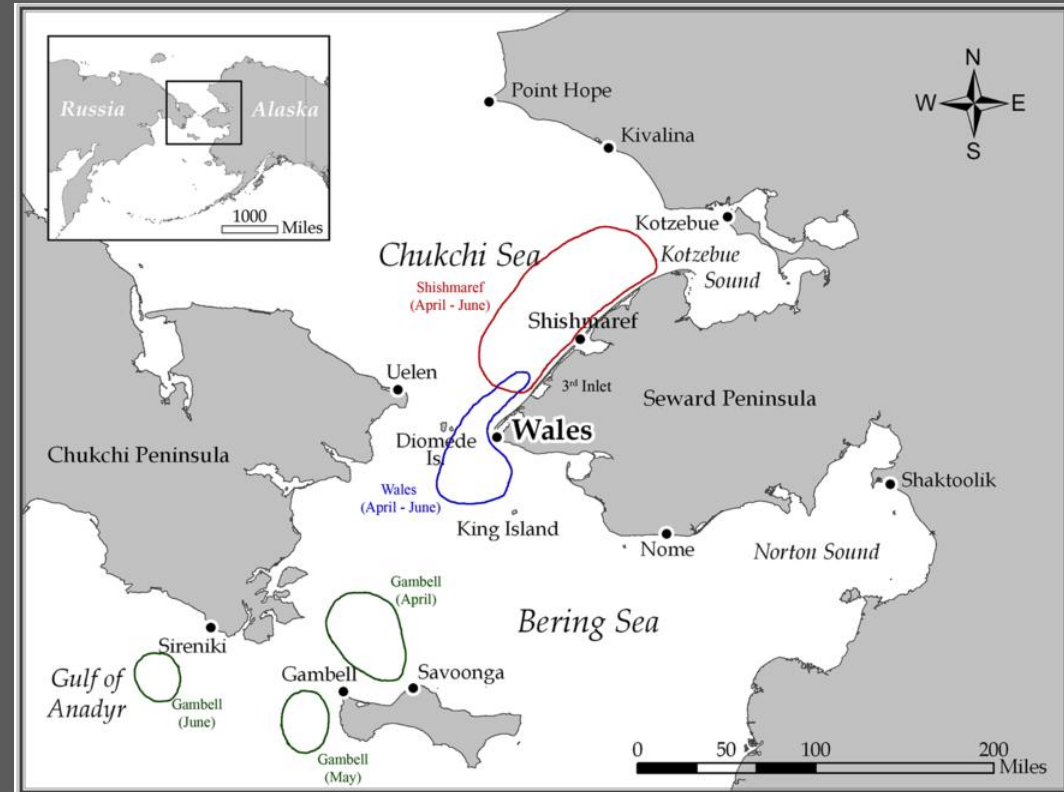
Kapsch et al., 2010: SIKU volume, ed. by I. Krupnik et al., Springer



Sea Ice for Walrus Outlook (SIWO)



- Dedicated 10-day forecast for N Bering, S Chukchi Seas (NWS)
- High-res satellite images
- Analysis of weather & ice patterns (NWS, NOAA, UAF)
- Observations from local experts
- www.arcus.org/search/siwo



- Ad-hoc input from scientists, indigenous experts & others

• Sea Ice for Walrus Outlook (SIWO): www.arcus.org/search/siwo



- SEARCH Science
 - Science News
 - Science Questions
 - Data
 - Related Links
- Sea Ice Outlook
 - Background
 - Media Coverage
 - Meetings
 - 2008 Outlook Archive
 - Related Websites
 - Sea Ice for Walrus Outlook
- SEARCH Projects
- Observing/AON
- SEARCH Structure
 - Development of SEARCH
 - Steering Committee
 - Panels
 - SMO
 - IPMC
 - SSC Workspace
- Resources
 - Meetings
 - International SEARCH
 - Contact Information
 - Home

Sea Ice for Walrus Outlook (SIWO)

[Printer Friendly/Low-Bandwidth Version](#)

Past SIWO Reports

Friday, 30 April 2010 - Sea Ice for Walrus Outlook

Latest News: The latest weekly SIWO report (23 April 2010) is now available - see below!

Overview

The Sea Ice for Walrus Outlook (SIWO), an activity of the [SEARCH Sea Ice Outlook](#), is a resource for Alaska Native subsistence hunters, coastal communities, and others interested in sea ice and walrus.

The SIWO is updated weekly with information on sea ice conditions relevant to walrus in the Northern Bering Sea and southern Chukchi Sea regions of Alaska. SIWO updates will be released every Friday through late June.

The SIWO webpage includes: (1) An assessment of current ice conditions relevant to distribution and access of walrus, (2) a 10-day outlook of wind conditions, (3) up-to-date satellite imagery for the Bering Strait and St. Lawrence Island, which are two regions of interest to coastal communities engaging in the walrus hunt, (4) written observations of ice development from Alaska Native hunters, sea-ice experts, or NOAA or university researchers, (5) additional data and resources on ice conditions, and (6) additional comments provided by local experts and other contributors.

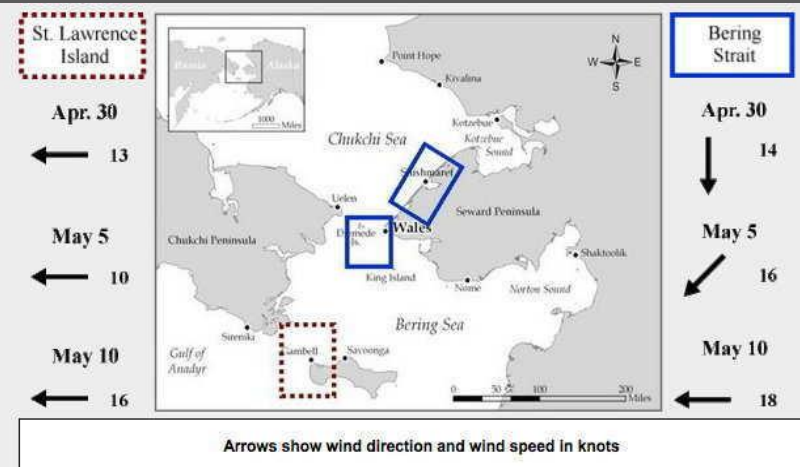
If you are a local hunter, expert, or a scientist with observations on either the development of sea ice or any other aspect of walrus and sea ice, please send your comments to Helen Wiggins at the Sea Ice Outlook Central Office at ARCUS; your comments will be posted to this page.

This collaboration includes weather and ice forecasters, climate scientists and sea-ice researchers at NOAA, the National Weather Service, and the University of Alaska who are teaming up with Alaska Native sea-ice experts and the Eskimo Walrus Commission. Key contacts are:

Kristina Creek, Ronnie Owens, Helen Wiggins - Sea Ice Outlook Central Office, ARCUS
 Vera Kingeekuk Metcalf - Eskimo Walrus Commission
 Hajo Eicken - University of Alaska Fairbanks
 Gary Hufford, Don Moore - National Weather Service
 Jim Overland, Nancy Soreide, Tracey Nakamura, Nick Bond - National Oceanic and Atmospheric Administration

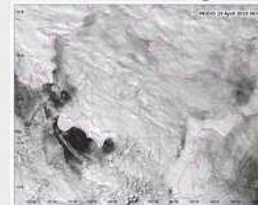


Photo by Maggie Prevenas - PolarTREC/ARCUS

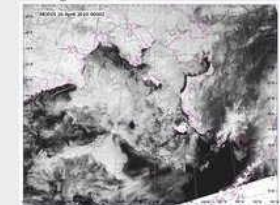


Remote Sensing Data

St. Lawrence Island/Bering Strait:



Bering Sea/Southern Chukchi Sea:



Archive of Recent Satellite Images Showing More Detail

- [St. Lawrence Island](#)
- [Bering Strait](#)

The links above take you to a user-friendly archive, through the Geographic Information Network of Alaska (GINA) website, which contains all the available high resolution satellite images for the two regions.

Additional Information on Ice Conditions



[FZAK80 Sea Ice Advisory](#)



[Sea Ice Analysis](#)



[Five Day Sea Ice Forecast](#)



[Sea Surface Temperatures Analysis](#)



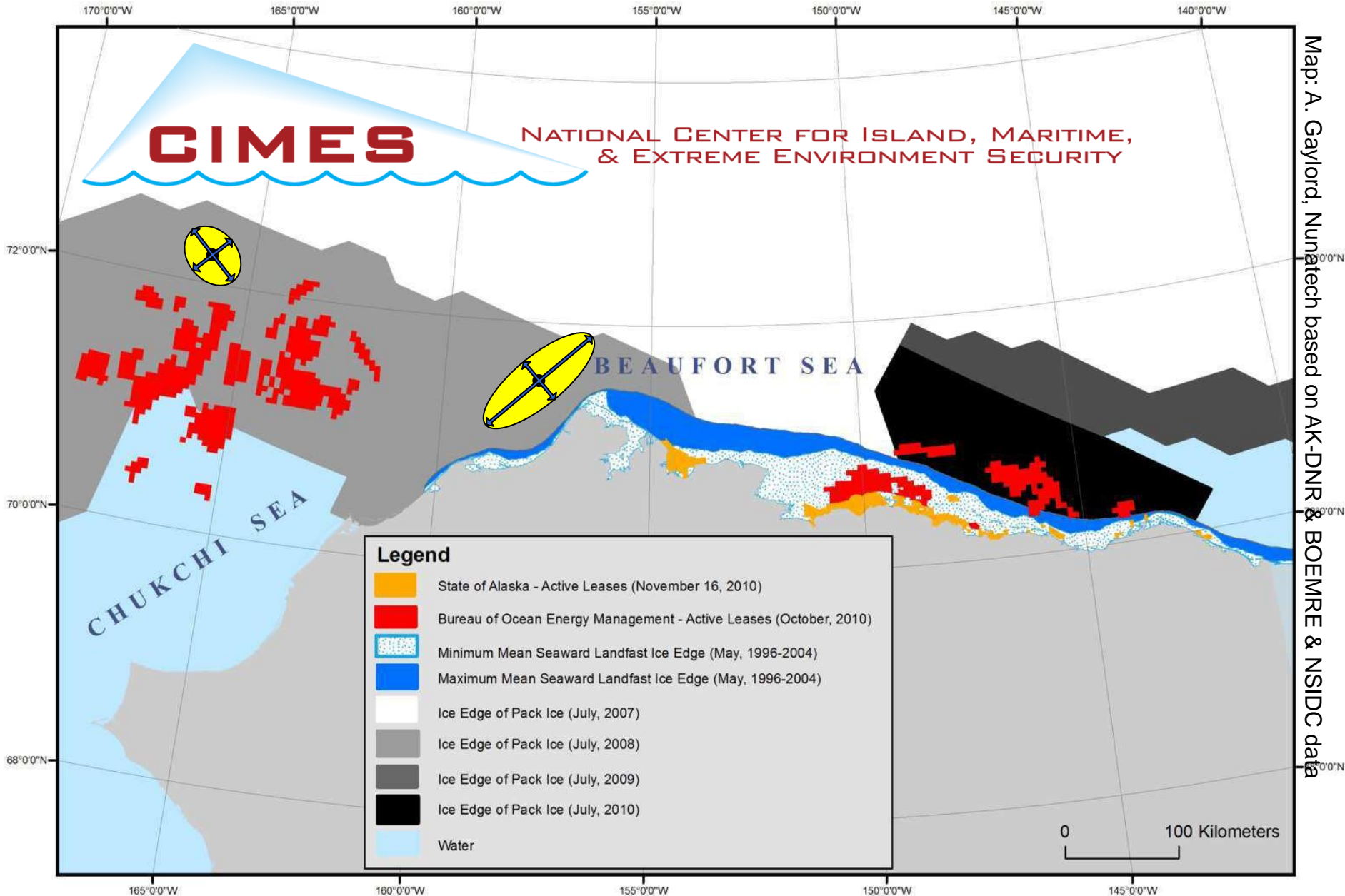
[East Bering Sea \(NIC\)](#)

Impacts of an ice-diminished Arctic on Alaska coastal communities



- Sea ice services & ice use
- Community-based observations & fall freeze-up
- Ice use as platform in spring
- An integrated ice observatory

Coastal & offshore oil & gas leases & sea ice

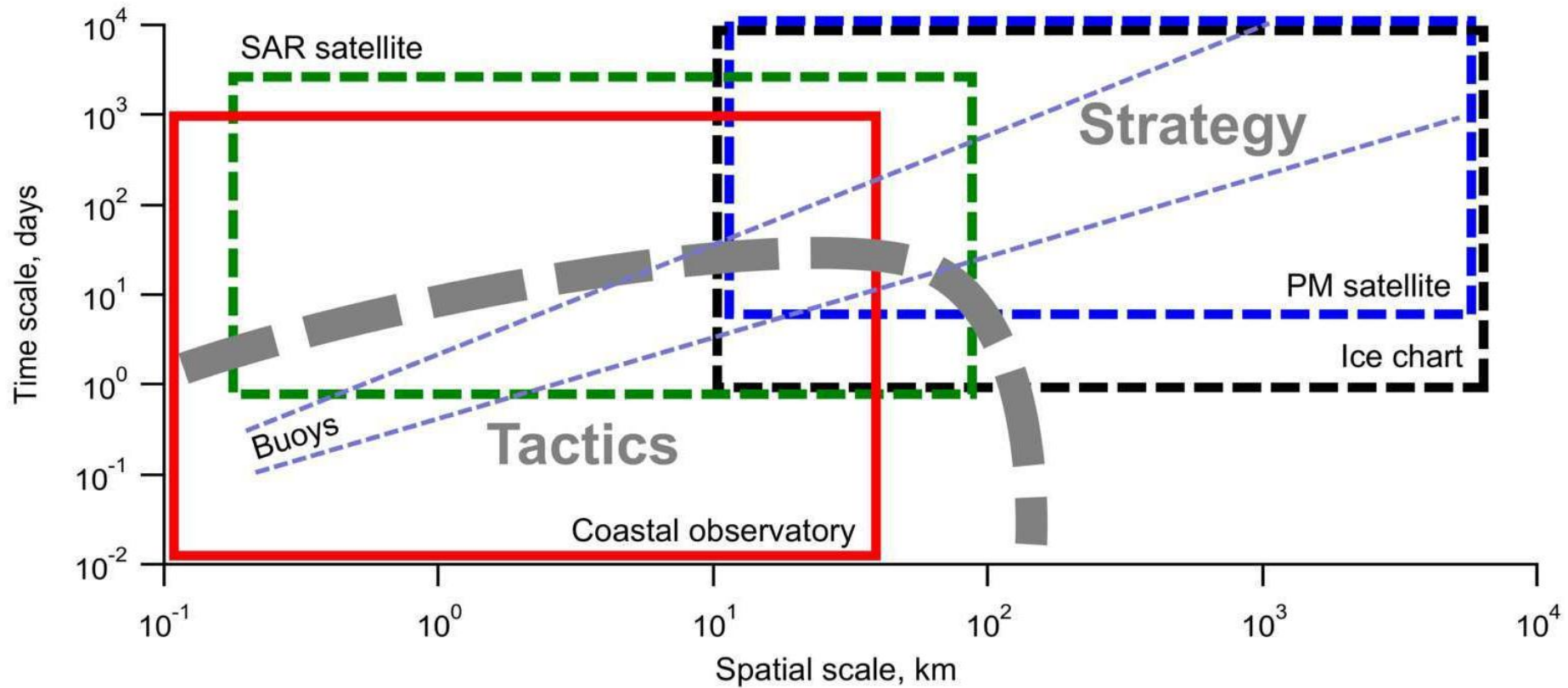


Environmental security: Relevant sea ice variables

Activity or asset	Hazard or threat	Ice variable	Setting/scale
<i>Shipping</i>	Ice contact & damage	Concentration, ice type	Marginal ice zone, 10s-100s km
<i>Use of ice as platform</i>	Ice break-out or breaking through of personnel & equipment	Stability, thickness, morphology	Landfast ice, <1-10s km
<i>Coastal & offshore infrastructure</i>	Loading, impact & damage by drifting ice, ice push & gouging	Velocity, floe size, thickness, ice type/strength	Coastal & offshore drift ice, <1-10s km
<i>Emergency/spill response</i>	Oil spill or vessel sinking in ice, dispersal of contaminants by ice	Velocity, trajectory of contaminated ice, morphology	Landfast & drift ice, <1-100s km

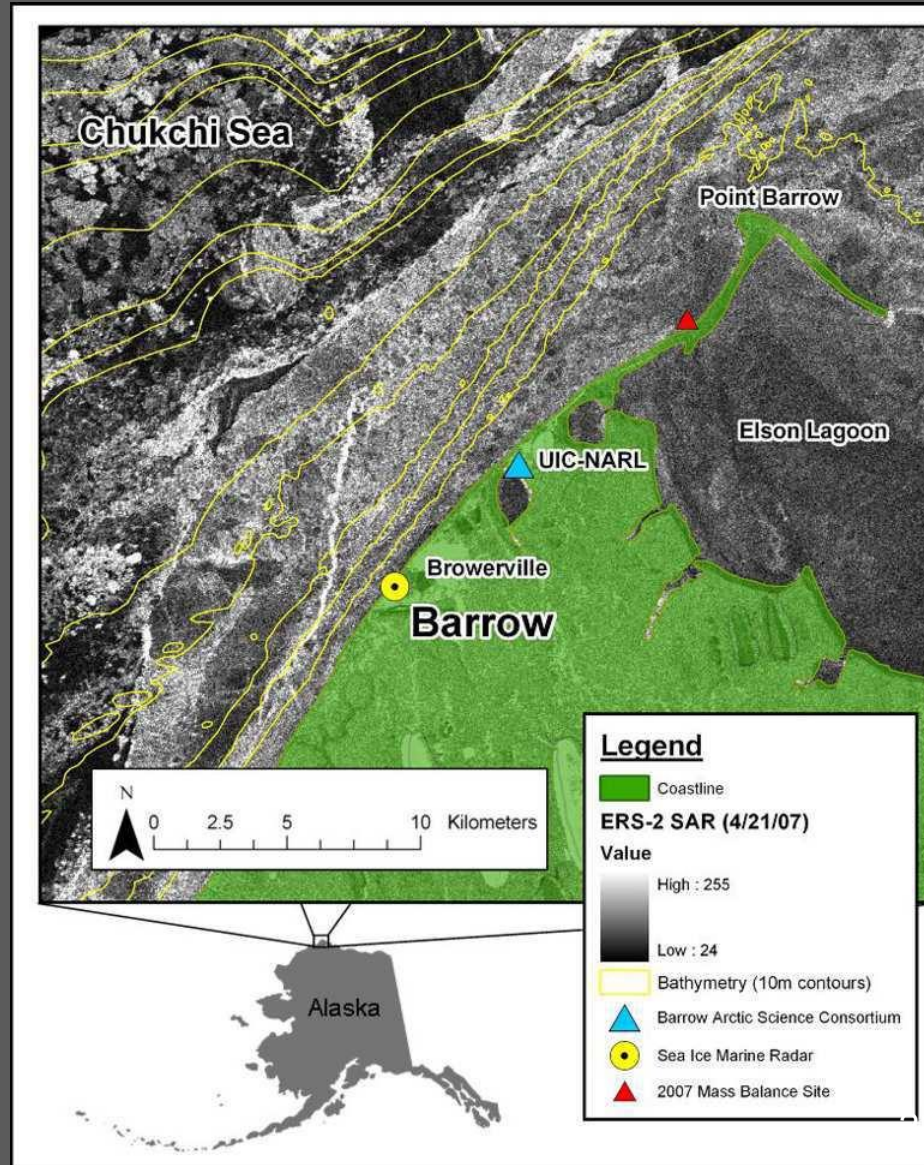
Arctic maritime environmental security: Strategic vs. tactical/operational perspectives

Eicken et al., Marine Technol. Soc. Journal, 2011 – CIMES Special Issue on MDA



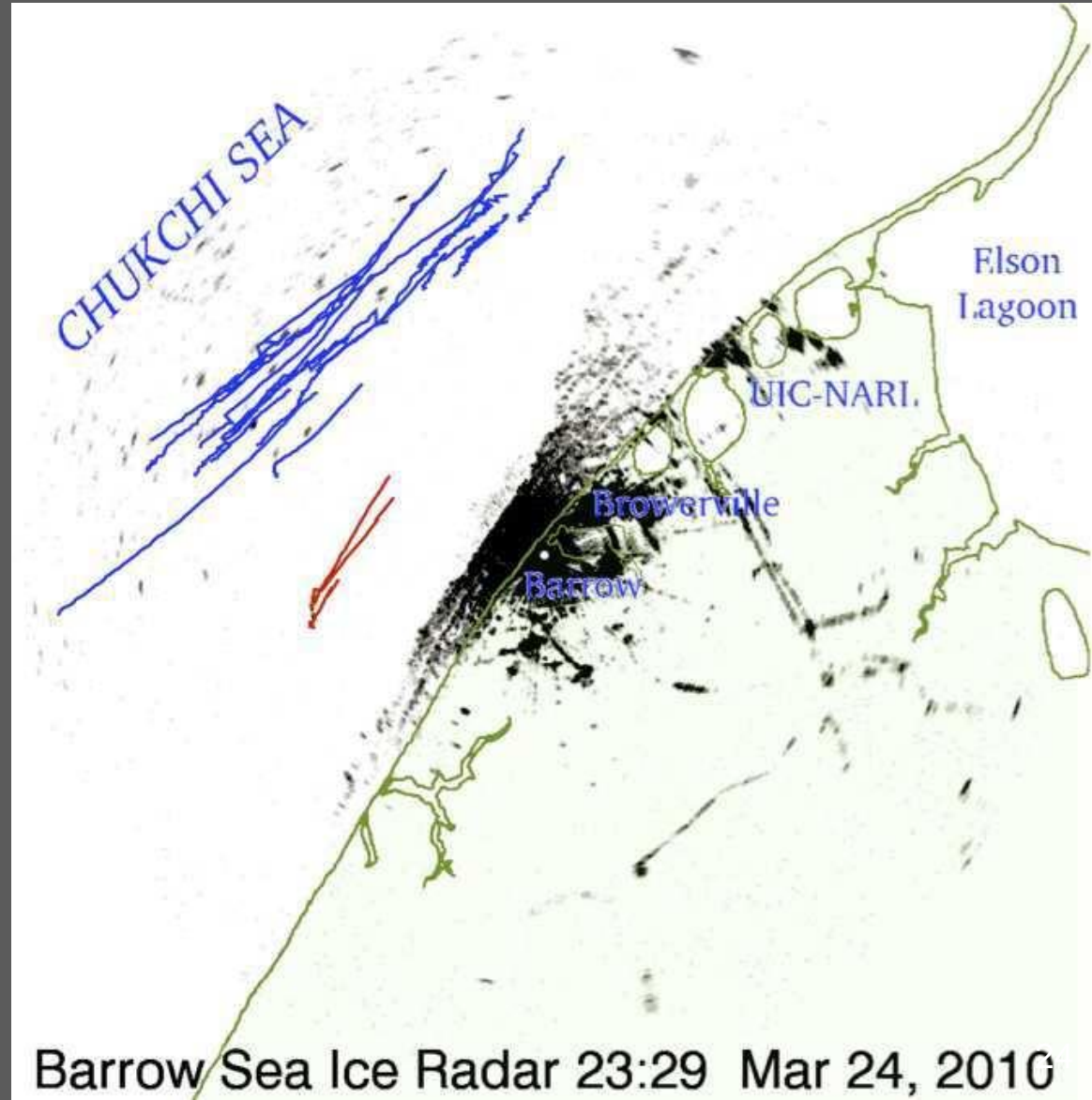
Improving cold-regions maritime domain awareness through an integrated coastal observing system

- *Remote sensing* (km-scale): Coastal environments & infrastructure, ice hazards
- *Coastal radar* (sub-km scale): Vessel & ice tracking, ice dynamics & potential disaster response
- *Aerial surveys, ice & sub-ice sensor systems*
- *Local knowledge*: Potentially important role for disaster response
- Integration of data streams



Motion Analysis: Detecting & Tracking Anomalous Motion

- Automated tracking of individual ice floes
- Detection of anomalous motion (non-linear acceleration/deceleration), e.g., grounding ice



Improved environmental security & emergency response through an integrated coastal observing system

